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ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (GEMS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER	
ABRAHAM, SALIEU M	

ART UNIT	PAPER NUMBER
3768	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

info@zpspatents.com
rlt@zpspatents.com
klb@zpspatents.com

Office Action Summary	Application No.	Applicant(s)	
	10/605,645	SARANATHAN ET AL.	
	Examiner	Art Unit	
	Salieu M. Abraham	3768	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 07/20/07.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-25 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-25 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _____ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Remarks/Arguments

1. Applicant's arguments filed July 20,2007 have been fully considered and the appropriate modifications have been made with respect to the claims in this second action on the merits.

2. With respect to Applicant's arguments regarding the 103(c) exclusion for all claims based in part on Pub. No. US 2005/0007110 A1 to Zhou (Zhou), the rejections are withdrawn. Therefore, all original FAOM rejections to claims 3-6, 11-19 and 22 are withdrawn.

3. As a result, new grounds of rejection have been made for these claims in addition to new rejections being made for all other amended claims, and this action is non-final.

Claim Objections

3. Claims 21 is objected to because of the following informality:

a. The Claim contains back-to-back references to the word " wherein".

Appropriate correction is required.

Claim Rejections - 35 USC § 101

4. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

5. Claim 25 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter (see sections relating to functional and nonfunctional descriptive material in MPEP 2106 <2106.01> and the "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility <signed 26

Oct 2005">).

In Reference to Claim 25

The claim explicitly cites "the computer program of claim 20" . The claim language is directed toward a computer program and is non-statutory (see reference to MPEP 2106 above).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1,2, and 10 are rejected under 35 U.S.C. 102(b) as being unpatentable over Pub. No. US 2001/0004211 to Ookawa (Ookawa) in view of US Pat. No. 6,380740 to Laub (Laub).

In Reference to Claim 1

Ookawa teaches:

A method of MR imaging comprising the steps of:

partitioning k-space into a number of partitions (see fig. 6 and section [0027] on page 2),

wherein the partitions incrementally increase in distance from a center of k-space (see fig. 6 and section [0031] on page 2);

Ookawa also explicitly teaches:

applying magnetic preparation pulses (flip pulse) and acquiring data such that a rate by which the magnetic preparation pulses are applied is a function of the incremental distance a partition of MR data is from the center of k-space (see fig. 5 and section [0031] on page 2). However Ookawa fails to explicitly teach "applying magnetic preparation pulses and acquiring data ***in an elliptic centric acquisition order,*** such that a rate by which the magnetic preparation pulses are applied is a function of the incremental distance a partition of MR data is from the center of k-space." Ookawa does disclose a 3D sampling and acquisition scheme that can be used for MR Angiography (MRA) and involves interrogating a "plurality of (annular) regions" (see fig. 6 and sections [0027] and [0031] on page 2) demarcated in "elliptic centric" fashion.

Laub discloses using 3D fast gradient pulse sequences in dynamic MRA studies for improving "spatial/temporal resolution " which employ elliptic centric acquisition order (see abstract, column 3, lines 23-64 and figures 6-9).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the elliptic centric data acquisition order of Laub in the method of Ookawa to further improve image spatial and temporal resolution as explicitly taught Laub.

<u>In Reference to Claim 2</u>

Ookawa in view of Laub has been shown to teach all of the limitations of claim 1.

In addition Ookawa further teaches:

The method of claim 1 wherein the magnetic preparation pulses are saturation pulses (e.g. pre-saturation pulse in Ookawa; see page 2, section [0021]), and

further comprising the step of decreasing the rate by which the saturation pulses are applied as the distance a partition of MR data is from the center of k-space increases (see fig. 6 and sections [0027] – [0031] on page 2, and sections [0032] and [0033] page 3).

In Reference to Claim 10

Ookawa in view of Laub has been shown to teach all of the limitations of claim 1. In addition Ookawa further teaches: The method of claim 1 wherein the data acquisition in k-space includes a radial acquisition in k-space (see figure 6). See also Laub column 3, lines 48-64.

Therefore, Ookawa in view of Laub teaches all claim 10 limitations.

8. Claims 3 through 6, 9 and 20-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub. No. US 2001/0004211 A1 to Ookawa (Ookawa) in view of US Pat. No. 6,380740 to Laub (Laub) further in view of US Pat. No. 5,245,282 to Mulger (Mulger).

In Reference to Claim 3

The claim states: "The method of claim 1 further comprising the step of playing

out at least one dummy acquisition after application of each magnetic preparation pulse."

Ookawa in view of Laub has been shown to teach all of the limitations of claim 1. However, Ookawa in view of Laub fails to teach "further comprising the step of playing out at least one dummy acquisition after application of each magnetic preparation pulse." In the applicant's disclosure the dummy pulse "while not required, may greatly improve image quality with the reduction of ghosting artifacts typically associated with steady state effects."

Mulger discloses applying a delay after a magnetic preparation pulse in order to achieve a desired contrast within an MR image (see abstract and column 1, lines 1- 68, and column 2, lines 1-29). It is also well known in the MRI art that dummy acquisitions are effective delay means, which can improve MR signal steady state conditions and reduce image noise.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included "the step of playing out at least one dummy acquisition after application of each magnetic preparation pulse" of Mulger in the method of Ookawa in view of Laub in order to improve the image contrast and reduce image acquisition time as taught by Mulger (see column 1, lines 56-68 and column 2, lines 1-19).

In Reference to Claim 4

The claim states: "The method of claim 3 further comprising the step of

playing out the magnetic preparation pulses every $N_i TR$ for an ith partition, wherein $N_1 < N_2 < N_{M-1} < N_M$, and M corresponds to the number of partitions."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 3 as discussed above. Ookawa further teaches "the step of playing out the magnetic preparation pulses every $N_i TR$ for an ith partition, wherein $N_1 < N_2 < N_{M-1} < N_M$, and M corresponds to the number of partitions" (see abstract, figs. 5 and 6, sections [0027] – [0031] on page 2, and sections [0032] – [0036] on page 3).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 4 limitations.

In Reference to Claim 5

Claim 5 states: "The method of claim 4 wherein the number of partitions includes three partitions for a given image acquisition, wherein N_i includes $N_1 < N_2$ and $N_2 < N_3$."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations claim 4. Ookawa further teaches that the number of (i.e. k-space) partitions (region divisions) may be "changed in various patterns" (see sections [0033] –[0036] on page 3) and "can be variously modified" to adjust the image contrast and the output of artifacts.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected three partitions as taught to optimally vary the number

of partitions in order to "adjust the image contrast and the output of artifacts" as explicitly taught in Ookawa.

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 5 limitations.

<u>In Reference to Claim 6</u>

Claim 6 states: "The method of claim 5 wherein the step of applying magnetic preparation pulses includes the step of playing out fat saturation pulses every five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 5. Ookawa further teaches that the rate or "frequency" at which (magnetization or) pre- pulses are played out may also be "changed in various patterns" (see sections [0034] –[0036] on page 3). Ookawa further teaches, " various patterns can be adopted for the division method of regions using different frequencies in the k-space, i.e., for region boundaries. A plurality of region division pattern data in the k-space may be prepared and may be selectively used in accordance with an instruction from the operator. These frequency patterns and region division patterns can be arbitrarily combined and used to arbitrarily adjust the image contrast and the output of artifacts." (see section [0035] on page 3)

It would have been obvious to one of ordinary skill in the art at the time of the

invention to have selected the "step of playing out fat saturation pulses every five TRs for the first partition, every 15 TRs for the second partition, and every 40 TRs for the third partition" in order to "adjust the image contrast and the output of artifacts" for the particular application at hand as taught by Ookawa.

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 6 limitations.

<u>In Reference to Claim 9</u>

Claim 9 states: "The method of claim 1 wherein the magnetic preparation pulses are fat saturation pulses, and further comprising the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 1. Additionally, Ookawa has been shown to teach the step of optimizing fat saturation based on the particular application at hand (see section [0035] on page 3). However, Ookawa fails to teach "the step of maximizing fat saturation while minimizing differential weighting of k-space while acquiring the central of region k-space."

It is well known in the art that dummy acquisitions as mentioned earlier may be used to address the issue of compensating for "differential weighting of k-space while acquiring the central of region k-space" that results from non-steady state sampling effects when a centric phase encoding technique is used.

It is in order to maintain steady state and minimize noise effects, that these delays are employed for peripheral-central region-based sampling .

It would have been obvious to one of ordinary skill in the art that the step of “minimizing differential weighting of k-space while acquiring the central of region k-space” would apply for sampling schemes which employed elliptic centric order acquisitions and which incorporated dummy acquisitions when transitioning between a peripheral region to the central region.

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 9 limitations.

In Reference to Claim 20

Ookawa in view of Laub teaches:

A computer readable storage medium having stored thereon a set of instructions that when executed by a computer (see Ookawa figure 1) causes the computer to:

- **partition** k-space data into a number of partitions (see Ookawa fig. 6 and section [0027] on page 2), each a given distance from a center of k-space (see Ookawa fig. 6 and section [0031] on page 2);
- **play out** a magnetic preparation pulse at a different rate for each partition, the rate being dependent on the given distance a partition is from the center of k-space (see Ookawa fig. 5 and section [0031] on page 2);
- **acquire** MR data in an elliptical centric order (see Laub abstract, column 3,

lines 23-64 and figures 6-9);

However, Ookawa in view of Laub does disclose:

A computer readable storage medium having stored thereon a set of instructions that when executed by a computer causes the computer to:

- **play out** at least one dummy acquisition during MR data acquisition.

Mulger has been shown to teach applying delays after magnetic preparation pulses in order to control image contrasts and it was established that the use of dummy acquisitions to effect delays and boost overall image signal to noise ratios is well known in the MR art (see claim 3 rejection).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 20 limitations.

<u>In Reference to Claim 21</u>

Ookawa in view of Laub further in view of Mulger has been shown to teach all limitations of claim 20. In addition Ookawa further teaches: ... wherein each partition is centered about a center of k-space (see figure 6) such that magnetic preparation occurs more frequently during MR data acquisition of a partition closer to the center of k-space than that of a partition farther from the center of k-space (see figures 5 and 6, and section [0033] on page 3).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 21 limitations.

In Reference to Claim 22

Claim 22 States: "The computer readable storage medium of claim 21 wherein a rate of magnetic preparation pulses is non-zero for each partition."

Ookawa in view of Laub further in view of Mulger has been shown to teach all the limitations of claim 21. In addition, Ookawa further discloses "wherein a rate of magnetic preparation pulses is non-zero for each partition" (see sections [0033] and [0034] on page 3).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 22 limitations.

In Reference to Claim 23

Claim 23 States: " The computer readable storage medium of claim 20 wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 20. Laub further teaches the step "wherein the set of instructions further causes the computer to define boundaries of each partition and determine the number of partitions based on a k-space extent of a 3D image FOV." Laub teaches the partitioning of k-space into 3D annular partitions so as improve spatial and or time resolution (see Laub figures 3,4 and 6, and column 3, lines 23-63). Laub further teaches that the selection of the number and relative

size of the segments may be varied and customized to the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 23 limitations.

In Reference to Claim 24

Claim 24 States: " The computer readable storage medium of claim 23 wherein the set of instructions further causes the computer to define the boundaries and the number of partitions such that k-space discontinuity between adjacent k-space views is reduced."

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 23. Laub further teaches that the 3D annular segments of his invention are bounded consecutively (respectively or one after the other) so that a central region is encompassed within a number of peripheral regions and that this approach improves spatial resolution over prior methods (see Laub figures 3,4 and 6, column 3, lines 28-63, column 7, lines 38-46). Also, the MR data is acquired using centric phase encoding. It is well known in the art that centric phase encode methods such as described by Laub employ techniques which minimize k-space discontinuities between adjacent k-space views.

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 24 limitations.

NOTE: Claim 25 was analyzed as best understood by the examiner to contain proper statutory language with regard to a computer program on a computer readable storage medium (see sections relating to functional and nonfunctional descriptive material in MPEP 2106 <2106.01> and the "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility (signed 26 Oct 2005)".

In Reference to Claim 25

Ookawa in view of Laub further in view of Mulger has been shown to teach all of the limitations of claim 20. In addition Ookawa further teaches: T he computer program of claim 20 "wherein the rate for each partition is non-linearly dependent on the given distance a partition is from the center of k-space (see figure 5 and sections [0033] -[0034] on page 3).

The contributions of Laub and Mulger to Ookawa with regard to "wherein the set of instructions further causes the computer to play out a dummy acquisition following each magnetic preparation pulse and prior to data acquisition in each partition have been discussed above (see claim 3 and 20 rejections, and Mulger abstract and figures 1 and 2).

Therefore, Ookawa in view of Laub further in view of Mulger teaches all claim 25 limitations

9. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pub.

No. US US 2001/0004211 A1 to Ookawa (Ookawa) in view of US Pat. No. 6,380740 to Laub (Laub) further in view of Stephen J. Riederer (Riederer), "Current Technical Development in Magnetic Resonance Imaging", IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

In Reference to Claim 7

Claim 7 states: "The method of claim 1 further comprising the step of determining the number of partitions based on an FOV from which MR data is to be acquired."

Ookawa in view of Laub has been shown to teach all of the limitations of claim 1. However, Ookawa in view of Laub does not explicitly teach "the step of determining the number of partitions based on an FOV from which MR data is to be acquired."

Riederer addresses a number of key technical developments in MRI for the year 2000. Among these is the significance of FOV selection in k-space for determining the speed of image acquisition (i.e. smaller FOV correlates to faster image acquisition and vice versa) and spacing between k-space views or lines or strips (e.g. k-space discontinuity between adjacent views; see middle column on page 36 and figs. 1(a) – 1(c)) for fast MRI scan methods where grabbing data as quickly as possible is essential. The number of elliptic centric (radially increasing) regions chosen in k-space vary in direct proportion to the FOV.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time of the invention to have included "the step of determining the number of partitions based on an FOV from which MR data is to be acquired" of Riederer in the method of Ookawa in order to obtain "greater image acquisition speed."

In Reference to Claim 8

Ookawa in view of Laub further in view of Riederer has been shown to teach all of the limitations of claim 7. Additionally, Riederer has also been shown to present a rationale for optimizing the spacing between consecutive k-space views according to claim 8 (see the "New Acquisition Strategies" section on pages 35 and 36 and figs. 1(a) – 1(c)).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included "the step of determining the number of partitions to minimize k-space discontinuity between adjacent k-space views" of Riederer in the method of Ookawa in order to optimize the FOV requirements for "greater image acquisition speed" with the k-space view spacing so as to reduce artifacts and improve image quality in the reconstructed image as taught by Riederer.

10. Claims 11-14,16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa).

In Reference to Claim 11

Claim 11 States: An MRI apparatus comprising (see figure 1) : a magnetic resonance imaging (MRI) system having a gradient coils positioned about a bore of a impress a polarizing magnetic field (see figure 1, reference marks 127, 139 and 141) and an RF transceiver system (figure 1, reference mark 150) and an RF switch (figure 1, reference mark 154) controlled by a pulse module (figure 1, reference mark 121) to transmit RF signals to an RF coil assembly (figure 1, reference mark 152) to acquire MR images; and a computer (figure 1, reference mark 107) programmed to: partition k-space into a number of partitions, each having an increased distance from a center of k-space (see column 4, lines 40-67, column 5, lines 1-2 and columns 6, lines 42-67 through column 8, line 1); apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition.

Therefore, Misretta teaches all of the apparatus elements of claim 11 (see figure 1) with the exception of the step to "apply magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition."

Ookawa has been shown to teach the application of magnetic preparation pulses in k-space according to region in which you are located (see section [0033] on page 3).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of applying "magnetic preparation pulses at a first rate during data acquisition for a first radial partition; and apply magnetic preparation pulses at a second rate, different from the first rate, during data acquisition for a second partition" of Ookawa to the MRI apparatus of Misretta in order to produce an MRI system that allows for the combination of variable rate magnetization preparation pulse sampling of multiple regions in order to control image contrast and output of artifacts as taught by Ookawa.

<u>In Reference to Claim 12</u>

Claim 12 States: "The MRI apparatus of claim 11 wherein the first rate and second rate are a function of partition distance from the center of k-space."

Misretta in view of Ookawa has been shown to teach all of the limitations of claim 12 with respect to claim 11. In addition, Ookawa further teaches the step "wherein the first rate and second rate are a function of partition distance from the center of k-space" (see section [0033] on page 3).

Therefore, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the first rate and second rate are a function of partition distance from the center of k-space" of Ookawa to modify the MRI apparatus of Misretta in order to shorten the photographing (image acquisition) time and ensure a "necessary image contrast" as taught by Ookawa.

In Reference to Claim 13

Claim 13 States: “The MRI apparatus of claim 11 wherein the first rate is **greater** than the second rate if the first radial partition is closer to the center of k-space than the second radial partition.”

Misretta in view of Ookawa has been shown to teach all of the limitations claim 11. In addition, Ookawa further teaches the step “wherein the first rate is **greater** than the second rate if the first radial partition is closer to the center of k-space than the second radial partition” (see section [0033] on page 3).

Therefore, Misretta in view of Ookawa teaches all claim 13 limitations.

In Reference to Claim 14

Claim 14 States: “The MRI apparatus of claim 13 wherein the saturation pulse is a magnetization preparation pulse.”

Misretta in view of Ookawa has been shown to teach all of the limitations claim 13. In addition, Ookawa further teaches the step “wherein the saturation pulse is a magnetization preparation pulse” (see section [0022] on page 2).

Therefore, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have included the step of “wherein the saturation pulse is a magnetization preparation pulse” of Ookawa to modify the MRI apparatus of Misretta in order to obtain flexible and custom variable rate magnetization pulse sampling of multi-partitioned k-space region for a desired

effect: images with high degree of fat suppression, good image contrast and minimal artifacts as taught by Ookawa.

In Reference to Claim 16

Claim 16 States: "The MRI apparatus of claim 11 wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse."

Misretta in view of Ookawa has been shown to teach all of the limitations of claim 11. In addition, Ookawa further teaches the step of "wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse" (see section [0021] on page 2).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the saturation pulses include at least one of a fat saturation pulse, an IR pulse, and a spatial saturation RF pulse" of Ookawa to modify the MRI apparatus of Misretta in order to improve image contrast as taught by Ookawa.

In Reference to Claim 18

Claim 18 States: "The MRI apparatus of claim 11 wherein the computer is programmed to carry out an elliptical centric phase order acquisition of MR data from at least one of a heart region and an abdominal region of a patient."

Misretta in view of Ookawa has been shown to teach all of the limitations of

claim 11. In addition, Misretta further teaches using a computer program within an MRI system to carry out "elliptical centric phase order acquisition of MR data" from different regions or tissues within the body; particularly those associated with the cardiovascular system (see column 1, lines 14-23, column 3, lines 60-67 and column 6, lines 42-50).

Therefore, Misretta in view of Ookawa teaches all limitations of claim 18.

11. Claim 15 is rejected over US Pat. No. 6,380740 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) further in view of US Pat. No. 5,245,282 to Mulger (Mulger).

<u>In Reference to Claim 15</u>

Claim 15 States: "The MRI apparatus of claim 11 wherein the computer is further programmed to play out a number of dummy acquisitions after each saturation pulse."

Misretta in view of Ookawa has been shown to teach all of the limitations of claim 11. In addition, Mulger in light of the state of the art at the time of the invention has been shown to provide a strong basis for the step of applying dummy acquisitions post saturation pulse in order to minimize noise-producing effects and maintain steady state of the MR signal when sampling between the peripheral and central regions of k-space (see claim 3 rejection).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step of "wherein the computer is

further programmed to play out a number of dummy acquisitions after each saturation pulse" of Mulger in the saturation pulse scheme of Misretta in view of Ookawa in order to shorten image acquisition time and improve image contrast as taught by Ookawa.

12. Claims 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) and further in view of Stephen J. Riederer (Riederer), "Current Technical Development in Magnetic Resonance Imaging", IEEE Engineering in Medicine and Biology Magazine, September/October 2000.

In Reference to Claim 17

Claim 17 States: "The MRI apparatus of claim 11 wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced."

Misretta in view of Ookawa has been shown to teach all of the limitations of claim However, Misretta in view of Ookawa fails to explicitly teach the step "wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced." Riederer teaches utilizing fast scan/imaging techniques that employ FOV calculation and compensation methods, which in turn have a direct bearing on k-space

discontinuities (see figs. 1a – 1c) and middle paragraph on page 36.

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the computer is further programmed to determine dimensions of an FOV and, from the dimensions, determine a number of radial partitions such that discontinuities between adjacent k-space locations are reduced" of Riederer in the elliptic centric phase order acquisition MR apparatus/system of Misretta in view of Ookawa in order to determine the spacing between k-space views (radial partitions) required for each k-space acquisition as taught by Riederer.

13. Claim 19, is rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat. No. 5,873,825 to Misretta (Misretta) in view of Pub. No. US 2001/0004211 to Ookawa (Ookawa) and further in view of US Pat. No. 6,380740 to Laub (Laub).

In Reference to Claim 19

Claim 19 States: "The MRI apparatus of claim 11 wherein the computer is programmed to partition k-space into partitions of similar size."

Misretta in view of Ookawa has been shown to teach all of the limitations of claim 11. However, Misretta in view of Ookawa fails to explicitly teach the step "wherein the computer is programmed to partition k-space into partitions of similar size." Laub teaches the partitioning of k-space into partitions of similar size (see Laub column 7, lines 7-26). Laub further teaches that the selection of the number and relative size of the segments may be varied and customized to

the application at hand so as to enable sufficient spatial and temporal resolution for tracking dynamic (fast) events within the body (see Laub, column 7, lines 13-21).

Therefore, it would also have been obvious to one of ordinary skill in the art at the time of the invention to have included the step "wherein the computer is programmed to partition k-space into partitions of similar size" of Laub in the magnetization preparation scheme and MRI system of Misretta in view of Ookawa in order to be able to obtain adequate and rapid spatial and temporal resolution for acquiring images using a rapid scanning technique.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Jezzard has been included because it teaches the importance of applying dummy acquisitions in order to obtain high contrast and reduced noise MR images.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Salieu M. Abraham whose telephone number is (571) 270-1990. The examiner can normally be reached on Monday through Thursday 9:30 am - 7:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eleni Mantis-Mercader can be reached on (571) 272-4740. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

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Eleni
ELENI MANTIS MERCADER
SUPERVISORY PATENT EXAMINER